A Survey of Lead in Soil from Seven Schools and Three Residential Areas of Winnipeg, 1983

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ABSTRACT

Lead levels were determined for soil and particulate debris from paved playground surfaces at seven Winnipeg schools during the summer of 1983. In addition, lead levels of boulevard sod and soil for three Winnipeg residential areas were determined. Lead levels at the school playgrounds are at acceptable levels. Higher lead levels were found in samples suspected of containing paint chips. Preventative measures are suggested to help minimize lead contamination at paved school yards. Lead levels in boulevard sod and soil are at acceptable levels, however there appears to be an association between lead-in-soil levels and proximity to major traffic routes.

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I INTRODUCTION

The Department of Environment and Workplace Safety and Health is concerned about the potential health implications of elevated lead levels in soil, in particular, for areas frequented by young children, such as school playgrounds. In 1981 the Environmental Management Division adopted the recommended Ontario Ministry of Environment guideline for lead in soil. Soils found to have 2600 µg/g of lead or more in areas frequented by young children are deemed to be unacceptable and removal or removal/replacement of contaminated material is recommended.

In 1982 the Environmental Management Division entered into a co-operative lead research project with the Atomic Energy of Canada at Pinawa and the Canadian Bronze Company Limited of Winnipeg to investigate the characterization or fingerprinting of individual particles originating from known sources of lead in Winnipeg. A report, "Lead Particulate Analysis in Air and Soil of the City of Winnipeg, 1982" was released by the Department of Environment and Workplace Safety and Health on June 1, 1983. A major conclusion of the report was that auto exhaust emissions appeared to be the primary source of lead at Weston Elementary School located adjacent to a principal traffic thoroughfare and near a secondary lead smelter. In addition, it was found that one year following a clean-up of lead contaminated soil at the school, lead-in-soil levels had returned to unacceptable levels. Further to this, concern was raised that high lead levels may be developing from auto exhaust emissions at other Winnipeg schools, due to their proximity to major traffic arteries.

As a follow-up to information presented in the above report the Environmental Management Division carried out a second clean-up of the north yard of Weston School on June 4, 1983. In addition, the lead program was expanded to include the evaluation of lead-in-soil levels from seven additional schools and three residential areas in the City of Winnipeg. The results of these surveys are presented herein.

II OBJECTIVES

The objectives of these surveys were;

1. To determine the lead levels in soil, dust and particulate debris from paved playgrounds at seven schools in the City of Winnipeg selected for proximity to major traffic thoroughfares and general similarity to Weston Elementary School.

2. To determine lead-in-soil levels from three residential areas of the City of Winnipeg selected for similarity to the Weston area with respect to age and development.

III PROCEDURES

A. SCHOOLS

(i) Selection Criteria

An initial selection of 37 schools was made based on maps of the school locations in each school division and traffic flow patterns in the City of Winnipeg. Site examinations were carried out on those schools which were closest to the highest traffic flows and which showed similarity to Weston School in orientation and physical make-up such as asphalt or concrete pavement in play areas located between the school building and the street.

The following seven schools were selected for follow-up lead-in-soil surveys:

1. Lord Nelson Elementary School - 820 McPhillips St.
2. Dufferin Elementary School - 545 Alexander Ave.
3. Sacre-Coeur Elementary School No. 2 - 775 Sherbrook St.
4. Gordon Bell High School - 3 Borrowman Pl.
5. Fort Rouge Elementary School - 120 Mayfair Ave.
6. Archwood Elementary School - 800 Archibald Ave.
7. Norberry Secondary School - 3 Holgat Ave.

(ii) Sample Collection

A 16-site sampling network was selected for each school ground in consideration of the need to reflect anticipated variation in the deposition and accumulation of dust and particulate debris at each site (Appendix 1 to 7).

Sampling of the schools was carried out during the first week of August. A sufficient sample of soil, dust or particulate debris was

collected directly off the playground surface using a plastic spoon and wisk. Each of the sixteen soil samples per school were individually stored in a plastic bag and taken to the W. H. Ward Technical Services Lab, 745 Logan Avenue, Winnipeg, for processing and analysis.

(iii) Sample Processing

Samples were placed in separate acid washed glass beakers and oven dried for approximately twenty-four hours at 100°C. The dried samples were ground to a fine texture using a mortar and pestle and screened through a Canadian Standard stainless steel No. 80 size sieve. The resulting soil material was placed into individual sterile glass specimen vials and analyzed for total lead by atomic absorption spectrophotometry. For each sample the mortar and pestle were washed and wiped dry using clean paper towels. The sieve was air blown to remove fine soil particles and then wiped using clean gauze pads.

(iv) Special Sample Considerations

During the collection stage samples suspected of being contaminated with paint chips were noted. The sample site number, it's location and lead level are flagged in the appendix for each school.

B. RESIDENTIAL AREAS

(i) Selection Criteria

The residential areas for boulevard lead in sod and soil sampling were selected for their similarity in age and development to the Weston area and their proximity to a major traffic route.

Based on these selection criteria the following residential locations were sampled;

1. Elmwood - (Henderson Hwy., north of Hespeler Ave.)
2. Riverview - (Osborne St., north of Jubilee Ave.)
3. Wolseley - (Portage Ave., west of Sherburn St.)

(ii) Sample Collection

Sample sites were predesignated on a City of Winnipeg street map (Appendix 8 - 10). Sample locations were selected to reflect lead levels in the residential boulevard sod and soil located adjacent to a major traffic thoroughfare and at various distances from the thoroughfare.

Sampling of the residential areas was carried out in July and late August. A two centimeter diameter stainless steel Oakfield soil corer was used to collect the sod and the upper five centimeters of soil A series of 10 sample cores were taken at each designated collection site. Each series of 10 cores for both the sod and soil were bulked separately and stored in plastic bags.

(iii) Sample Processing

Samples were taken to the W. M. Ward Technical Services Lab where they were placed separately into acid washed glass beakers and oven dried at 100°C for about twenty-four hours. The dried samples were ground to a medium texture using a mortar and pestle, and screened through a Canadian Standard stainless steel No. 7 size sieve. The soil material which passed the No. 7 sieve was reground with mortar and pestle to pass through a No. 80 size sieve.

The resulting dust-like material was then placed into individual sterile glass specimen vials and submitted for lead analysis. For each sample the mortar and pestle were washed and wiped dry using clean paper towels. The sieves were air blown to remove fine soil particles and then wiped using clean gauze pads. The sod and soil samples were analysed for total lead concentration by atomic absorption spectrophotometry.

IV RESULTS

(i) School Surveys

Lead values found at Lord Nelson Elementary School ranged from a low of 205 µg/g to a high of 2400 µg/g (Appendix 1). Four samples were flagged as having suspected paint chips in the sample. Of the sixteen samples collected the three highest were those suspected of having paint present. Generally, the lead levels found in samples collected close to McPhillips Avenue, a major traffic route, were considerably higher than the samples collected further away from this street.

At Sacre-Coeur Elementary School #2 lead values ranged from a low of 115 µg/g to a high of 1100 µg/g (Appendix 2). Two samples had suspected paint chips, one having the highest lead level for the school. Higher levels appear to be associated with samples located on the north side of the play area adjacent to a parking lot and along Sherbrook Street, a major thoroughfare.

Lead levels found at Dufferin Elementary School ranged from a low of 555 µg/g to a high of 1400 µg/g (Appendix 3). Four samples were noted to contain suspected paint chips. One of these four sites contained a sufficiently large quantity of the suspected paint chips intermixed with soil debris that the quality of the sample was in question and no analysis was performed. Of the remaining three samples containing suspected paint chips, one had the second highest lead level on the site and the other two ranked third lowest and sixth lowest in lead concentration. The highest levels were from those sites located closest to Logan Avenue, a major traffic route.

For Gordon Bell High School lead concentrations ranged from a low of 45 µg/g to a high of 1900 µg/g (Appendix 4). No samples were flagged as containing suspected paint chips. The highest lead values appear to be concentrated along Broadway Street, a major thoroughfare,

but not along Maryland Avenue, another main traffic artery. It is not known why this occurs, however orientation to predominant winds may be a factor. Lead levels are reduced at sites located farther away from Broadway Avenue.

At Fort Rouge Elementary School lead levels ranged from a low of 630 µg/g to a high of 1850 µg/g (Appendix 5). Five samples contained suspected paint chips. Of these five samples one had the highest level for the sampling network and two others ranked fifth and sixth. The highest lead levels appear to be concentrated along Mayfair Avenue, a main feeder route, and along the parking lot at the east side of the school yard.

For Archwood Elementary School lead levels ranged from a low of 70 µg/g to a high of 670 µg/g (Appendix 6). No samples were suspected of being contaminated with paint chips. The highest concentrations of lead appeared in samples located along Archibald Avenue, a main traffic corridor.

Lead levels at Norberry High School ranged from a low of 80 µg/g to a high of 910 µg/g (Appendix 7). No samples were flagged as having suspected paint chips. Higher levels appear to be concentrated along St. Mary's Road, a major traffic artery. The two highest concentrations were found at the northeast entrance of the complex and may be due to a possible eddying pattern of wind flow and resulting deposition adjacent to the building.

(ii) <u>Residential Surveys</u>

For the Riverview - Osborne Street area the levels of lead in sod ranged from a low of 36 µg/g to a high of 1044 µg/g (Appendix 8). In soil the lowest level was 36 µg/g and the highest was 648 µg/g. The highest levels generally occurred along Osborne Street, a major traffic route, and along Jubilee Avenue, also a major feeder route.

Lead levels in sod for the Elmwood-Henderson Highway area ranged from a low of 10 µg/g to a high of 1600 µg/g (Appendix 9). In soil the lowest lead level was 20 µg/g and the highest was 700 µg/g. The highest levels appear to be concentrated along Henderson Highway and Hespeler Avenue, both major traffic arteries.

For the Wolseley - Portage Avenue area, the levels of lead in sod ranged from a low of 150 µg/g to a high of 1100 µg/g (Appendix 10). In soil the lowest lead level was 30 µg/g and the highest 1400 µg/g. The highest levels appear to be concentrated along Portage Avenue, a major traffic route.

V CONCLUSIONS

1. The lead levels at the paved palyground areas of the schools sampled are at acceptable levels.

2. Lead levels in sod and soil from boulevards of residential areas sampled are at acceptable levels.

3. There is an association between lead-in-soil levels and the proximity to major traffic routes.

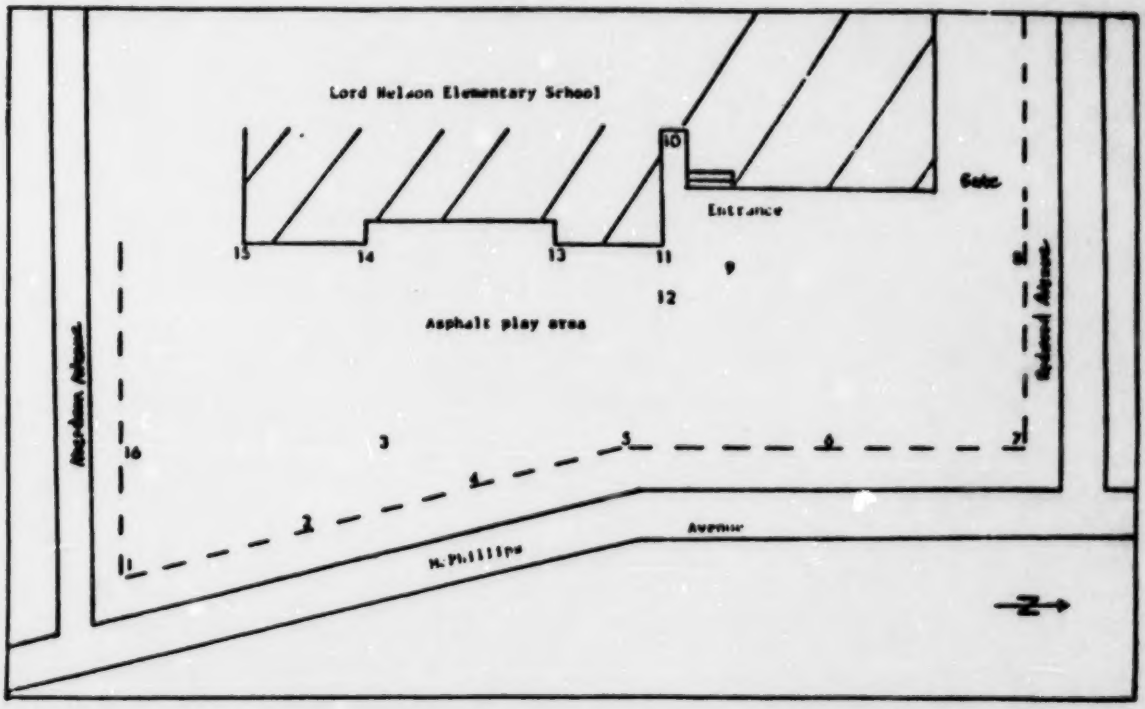
4. Higher lead levels were found in samples suspected to be contaminated with paint chips.

5. The situation at Weston Elemetary School appears unique to that area.

6. Lead contamination could be minimized on paved school yards by:
   a) ensuring that painted surfaces are in good repair and that repainting is carried out with lead free or low lead paint.
   b) guttering of surfaces and in particular the base of buildings adjacent to the paved surfaces to promote runoff and reduce accumulation.
   c) designing proper fencing to minimize the entrapment of soil debris.
   d) maintaining school pavement in good condition by carrying out appropriate inspections and by filling cracks and joints.
   e) sloping school pavement in an appropriate fashion to encourage run-off of vagrant material.
   f) regularly cleaning off the school pavement, ensuring the removal of soil, dust and particulate debris by frequent hosing down of the surfaces.

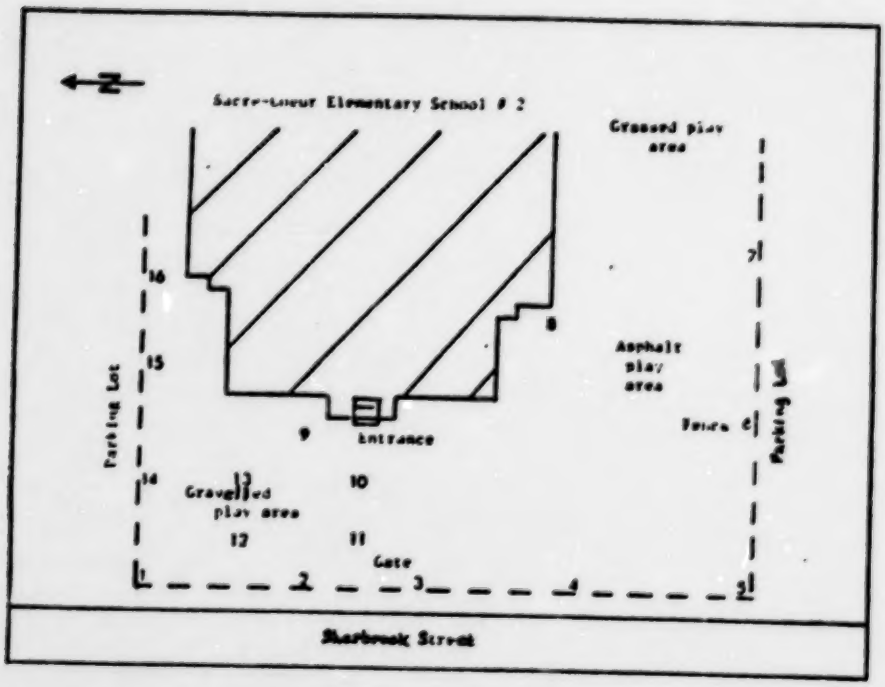
VI APPENDICES

Appendix 1



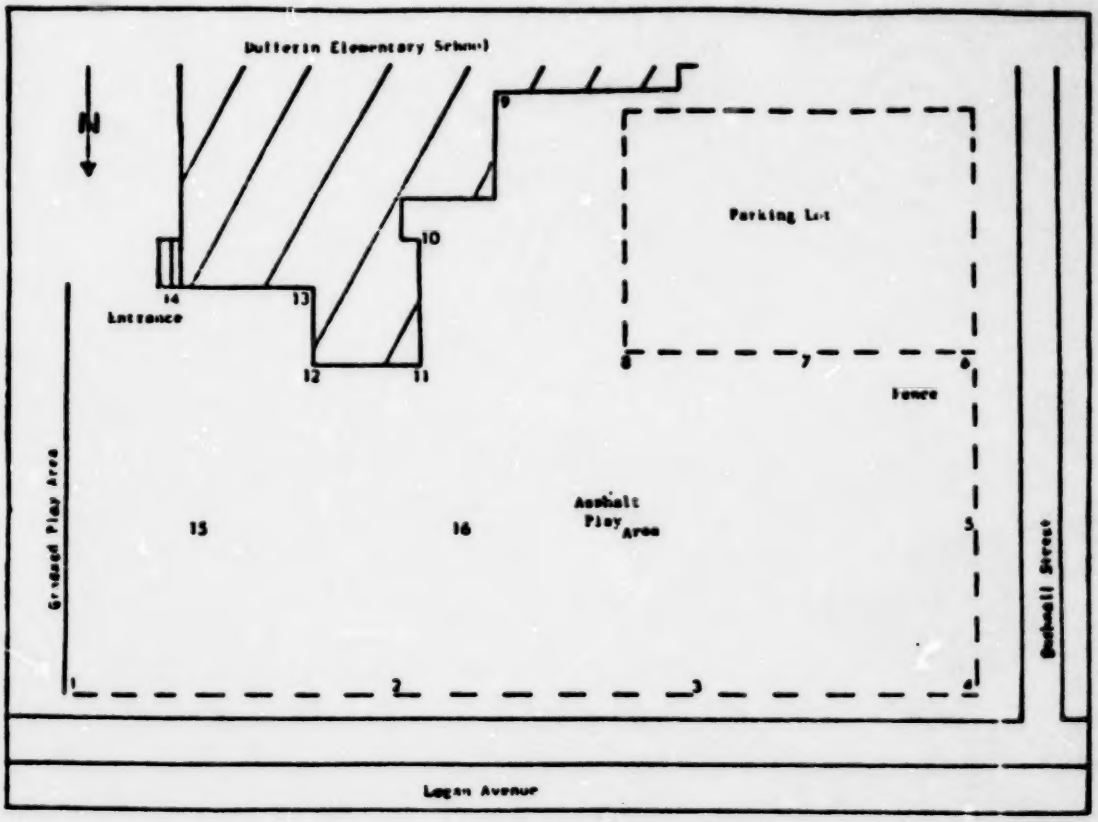
Soil Sample Site #	Total Lead in Soil Level (ug/g)
LN 1	1500
LN 2	2300
LN 3	1600*
LN 4	2000*
LN 5	1250
LN 6	1100
LN 7	1750*
LN 8	430
LN 9	790
LN 10	330
LN 11	400
LN 12	400
LN 13	205
LN 14	560
LN 15	690
LN 16	3400*

Appendix 2



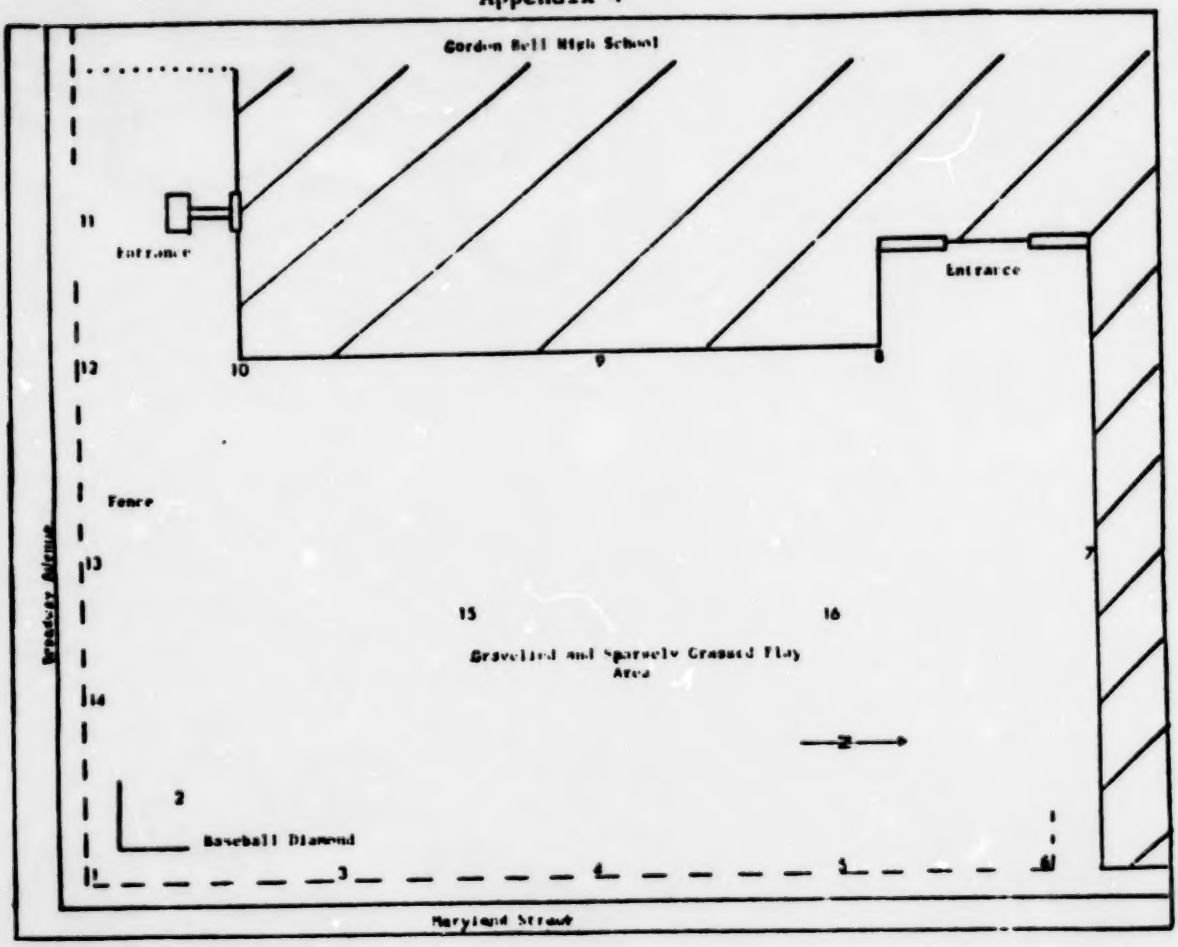
Soil Sample Site #	Total Lead in Soil Level (ug/g)
SC 1	300
SC 2	630
SC 3	655
SC 4	830
SC 5	1300
SC 6	690
SC 7	1100*
SC 8	270
SC 9	125
SC 10	320*
SC 11	590
SC 12	340
SC 13	560
SC 14	230
SC 15	320
SC 16	260

Appendix 3



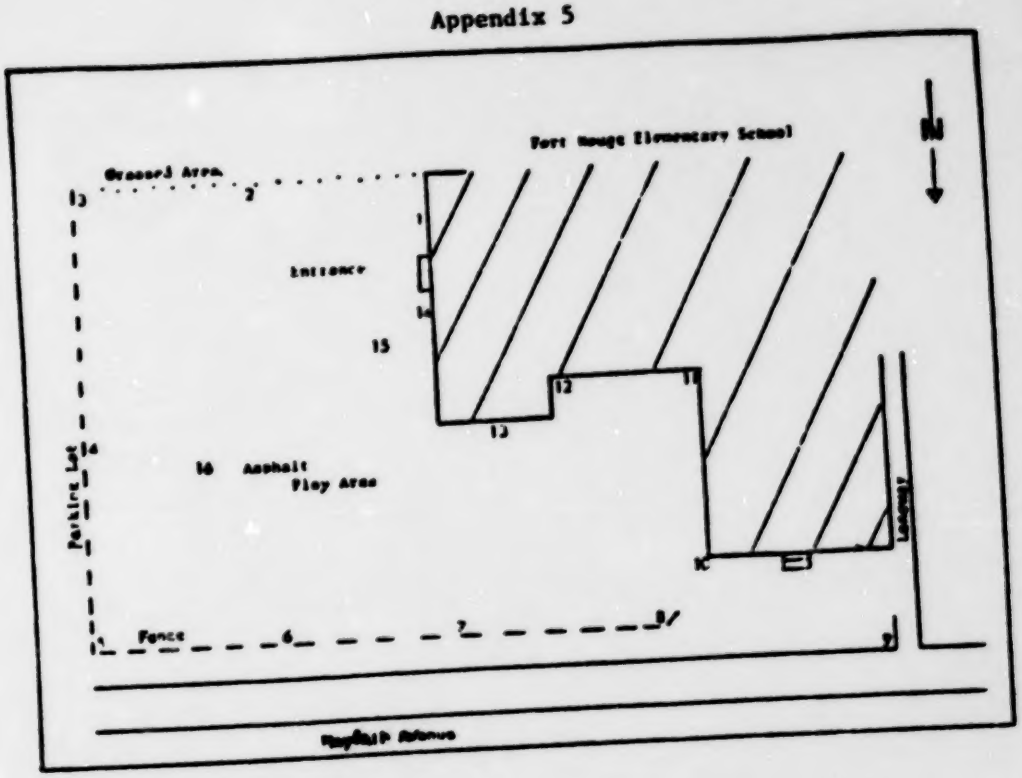
Soil Sample Site #	Total Lead in Soil Level (ug/g)
D 1	1100
D 2	1120
D 3	1400
D 4	980
D 5	1050
D 6	970
D 7	850
D 8	610
D 9	900
D 10	1200*
D 11	930
D 12	960
D 13	(no sample to many paint chips)
D 14	555
D 15	950*
D 16	800*

Appendix 4



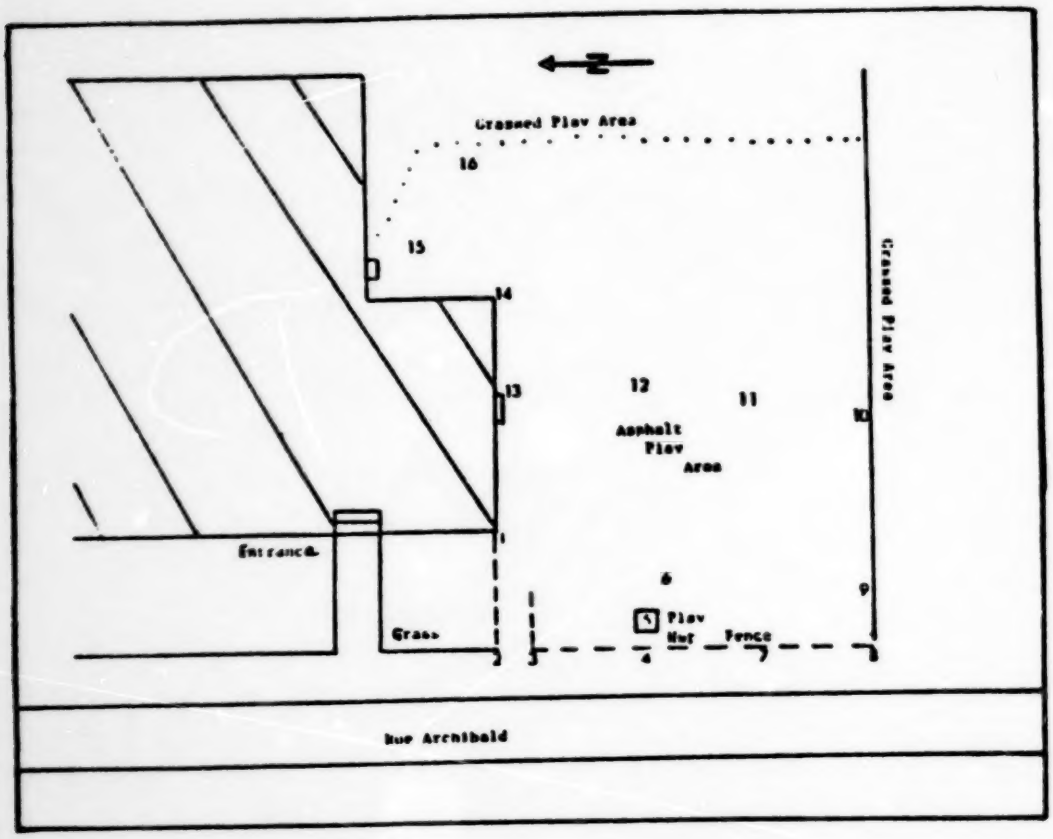
Soil Sample Site #	Total Lead in Soil Level (ug/g)
G B 1	950
G B 2	310
G B 3	435
G B 4	440
G B 5	440
G B 6	330
G B 7	515
G B 8	1100
G B 9	440
G B 10	45
G B 11	1900
G B 12	1850
G B 13	1050
G B 14	1550
G B 15	210
G B 16	180

Appendix 5



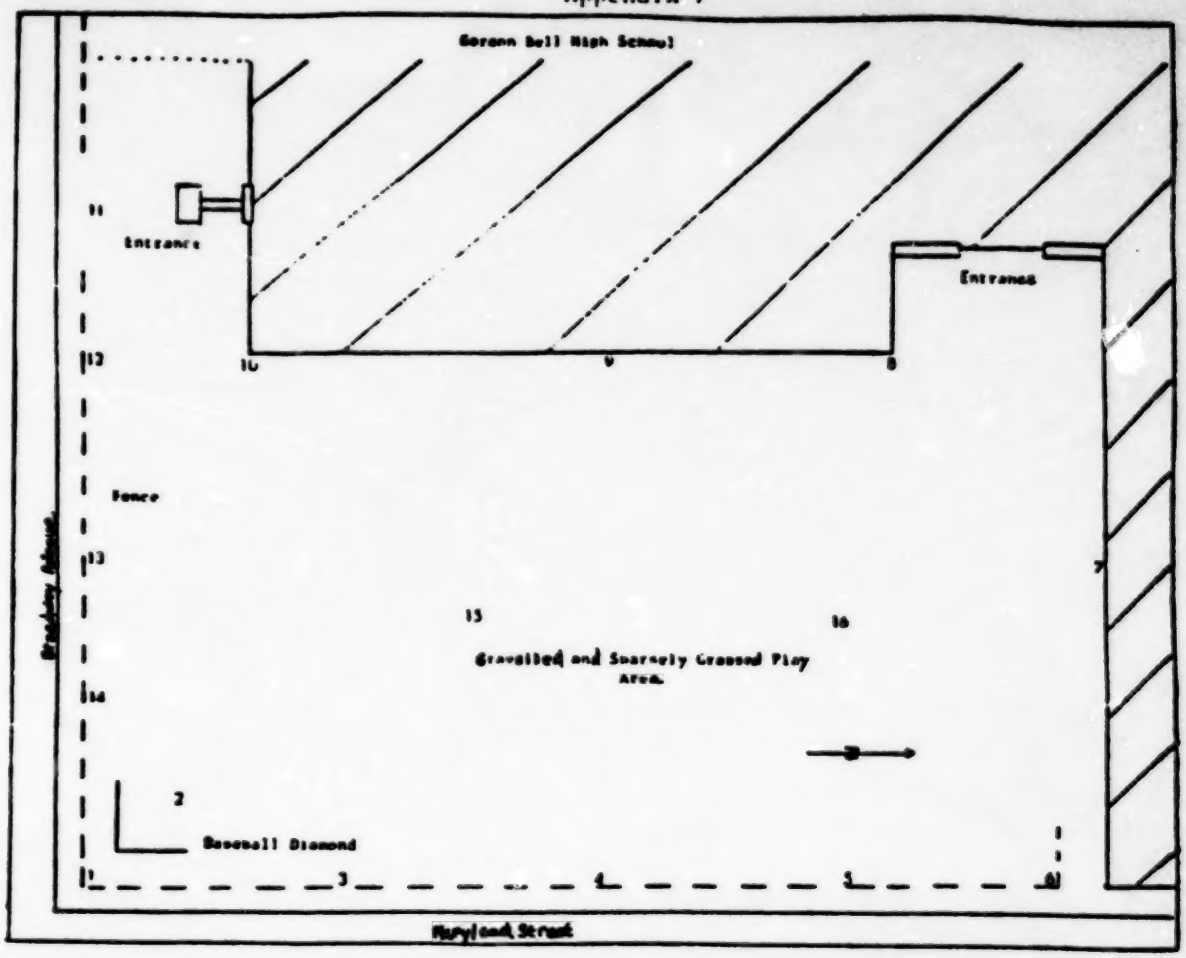
Soil Sample Site #	Total Lead in Soil Level (ug/g)
FR 1	670*
FR 2	1000
FR 3	1050
FR 4	1000*
FR 5	1[illegible]*
FR 6	930
FR 7	1200
FR 8	1300
FR 9	630
FR 10	780
FR 11	870
FR 12	840
FR 13	1080*
FR 14	830
FR 15	950
FR 16	80[illegible]*

Appendix 6



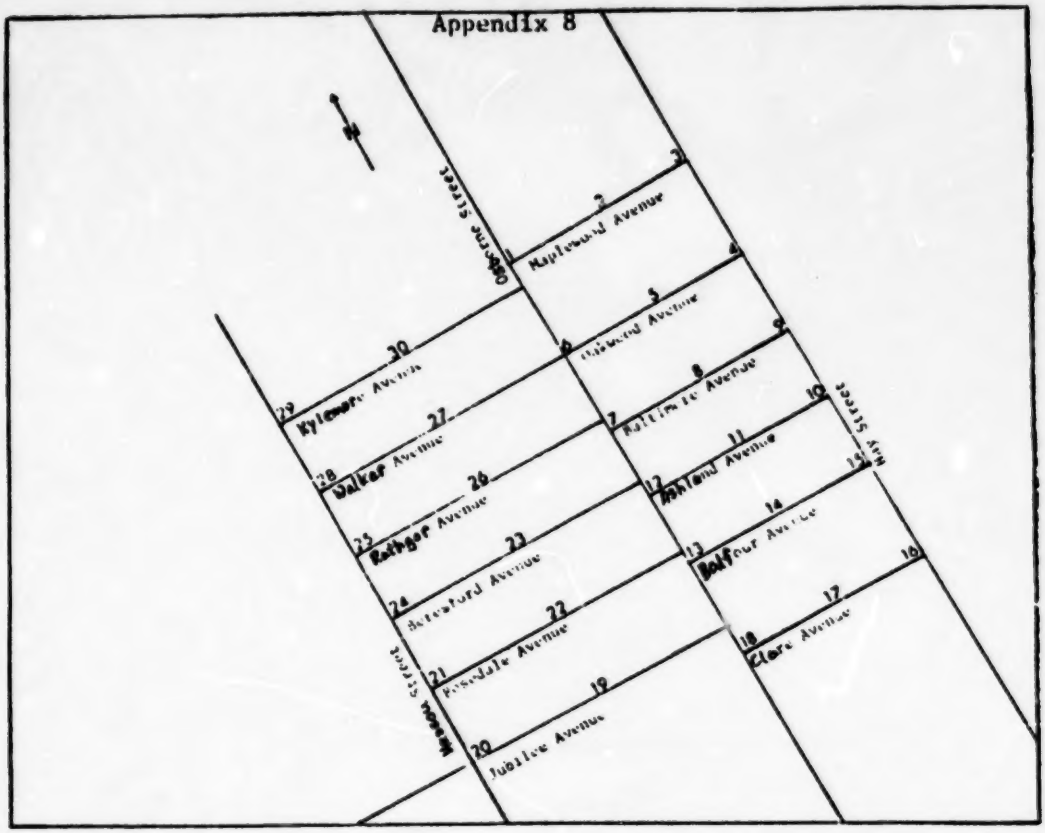
Soil Sample Site #	Total Lead in Soil Level (ug/g)
A 1	110
A 2	360
A 3	530
A 4	570
A 5	70
A 6	400
A 7	520
A 8	610
A 9	530
A 10	430
A 11	350
A 12	300
A 13	230
A 14	230
A 15	670
A 16	70

Appendix 7



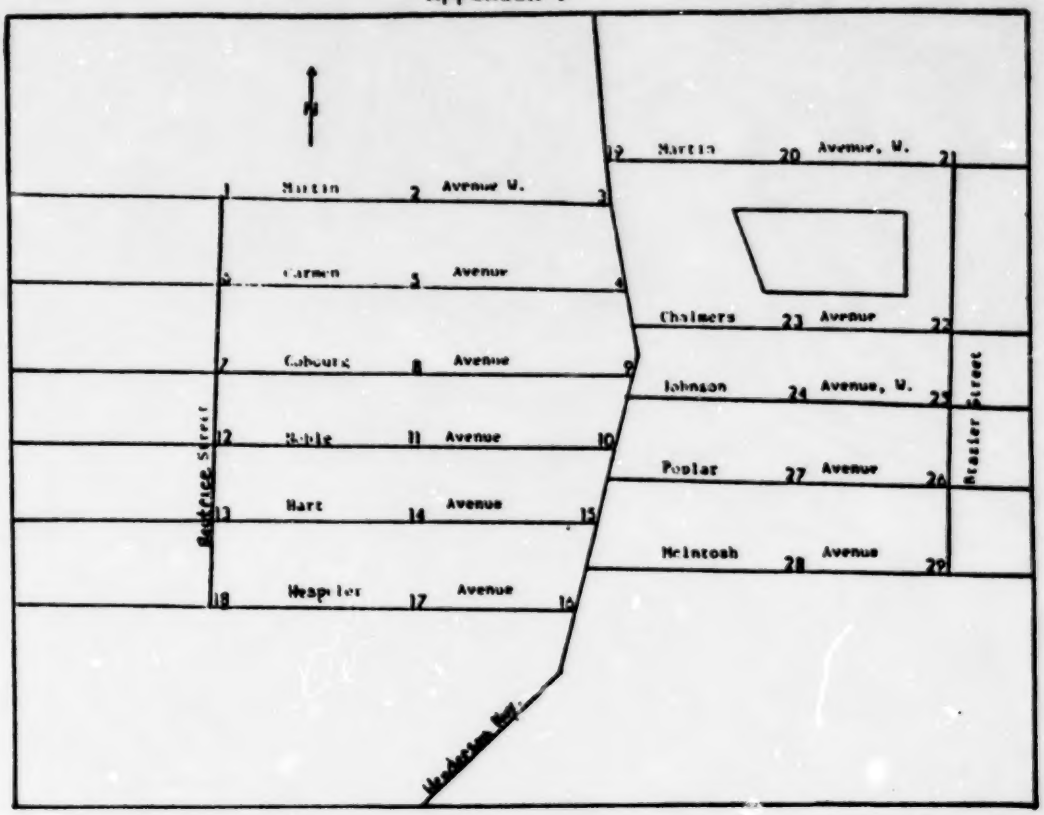
Soil Sample Site #	Total Lead in Soil Level (ug/g)
N 1	500
N 2	700
N 3	650
N 4	600
N 5	215
N 6	160
N 7	230
N 8	195
N 9	80
N 10	305
N 11	480
N 12	410
N 13	910
N 14	800
N 15	160
N 16	555

Appendix 8



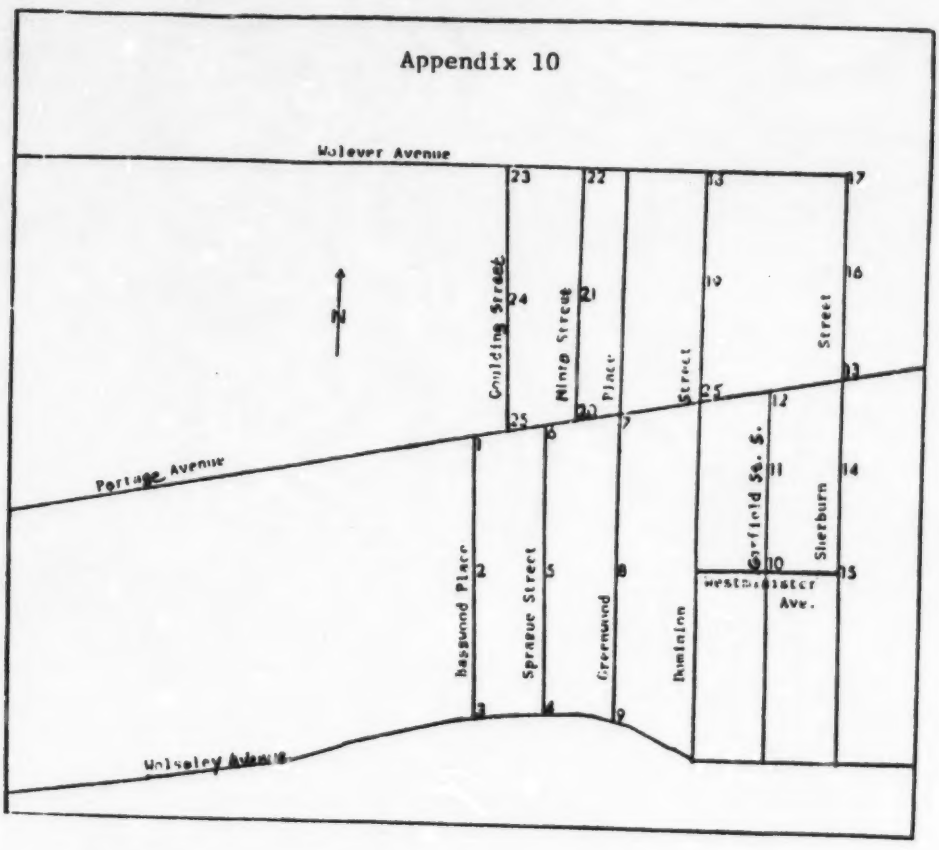
Soil Sample Site #	Total Lead (µg/g)	
	in Sod	in Soil
1	1044	348
2	144	84
3	168	108
4	48	48
5	48	36
6	144	36
7	348	72
8	60	36
9	108	48
10	48	36
11	36	36
12	264	36
13	720	348
14	84	144
15	108	84
16	84	96
17	192	456
18	816	528
19	600	648
20	276	144
21	384	240
22	348	288
23	360	252
24	336	276
25	240	240
26	372	252
27	348	216
28	372	300
29	132	372
30	312	216

Appendix 9



Soil Sample Site #	Total Lead (ug/g)	
	In Sod	In Soil
1	310	310
2	300	370
3	640	530
4	820	590
5	320	200
6	320	290
7	290	290
8	180	140
9	700	480
10	80	90
11	300	280
12	290	310
13	10	90
14	10	40
15	70	40
16	1600	580
17	900	450
18	980	410
19	710	700
20	420	440
21	30	80
22	210	110
23	170	160
25	420	440
26	150	50
27	130	50
28	260	20
29	340	450

Appendix 10



Soil Sample Site #	Total Lead (ug/g)	
	In Sod	In Soil
1	1100	1400
2	260	240
3	260	100
4	220	160
5	200	220
6	800	1000
7	600	300
8	180	160
9	210	170
10	360	200
11	240	220
12	620	800
13	680	700
14	380	270
15	450	320
16	310	260
17	380	320
18	600	580
19	740	780
20	150	30
21	190	200
22	240	130
23	150	160
24	360	370
25	220	460